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ABSTRACT

Although expectancies for alcohol have been shown to influence drinking behavior, current expectancy questionnaires do not lend themselves to the study of how expectancies are represented in memory. Two studies were conducted which utilized multidimensional scaling techniques designed to produce hypothesized representations of cognitive structures. In one study, the cognitive representation of effects of alcohol were compared for college student drinkers (N=144). Heavy drinkers appeared to expect more social/positive and arousing effects than did light drinkers. These results suggest that positive and arousing effects of alcohol are strong associates for heavy drinkers, suggesting that this information may be rapidly retrieved and disproportionately influence decision making about drinking in heavy drinkers. In the other study, drinkers' (N=271) representations of the effects of alcohol were compared across situations. Expectancies involving effect and behavior appeared to be separate from other expectancies in the "dinner" situation whereas they appeared to be integrated with other expectancies in the "sexual" situation. These results suggest that situational differences in drinkers' cognitive structures can be studied via multidimensional scaling techniques using measures that are sensitive to contextual differences. Both studies yielded "cognitive maps" which suggest mechanisms by which decisions to drink are made. (ABL)

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Multidimensional Scaling for Measuring Alcohol Expectancies

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ABSTRACT

Although expectancies for alcohol have been shown to influence drinking behavior, current expectancy questionnaires do not lend themselves to the study of how expectancies are represented in memory. Two studies are described which utilize statistical techniques (e.g., multidimensional scaling) that are designed to produce hypothesized representations of cognitive structures. In one study, the cognitive representation of effects for alcohol are presented for heavy versus light drinkers. In another study, drinkers' representations of the effects of alcohol are compared across situations. Both studies yielded "cognitive maps" which suggest mechanisms by which decisions to drink are made.

INTRODUCTION

Expectancies for the reinforcing properties of alcohol have been repeatedly shown to influence drinking behavior. Several instruments (e.g., the Alcohol Expectancy Questionnaire (AEQ)) have been successful in identifying a broad range of alcohol-related expectancies and their variations across individuals (see Goldman, Brown, & Christiansen, 1987 for review). Ongoing longitudinal studies have shown expectancies to provide predictive power of drinking habits in adolescents and adult drinkers. These results have been consistent with experimental studies, most notably those using the balanced placebo design (Marlatt & Rohsenow, 1980).

The view taken here is that alcohol expectancies are stored representations of if-then relationships between alcohol use and behavioral outcomes that can be studied by drawing upon established methodologies from cognitive psychology. While the factor analytic techniques used to produce the current measures of expectancies produce scales which are useful for studies of prediction, they are limited in their ability to elucidate the cognitive structure of alcohol expectancies. For example, one can not investigate how the constructs represented by the different factors are interrelated in subjects' memory.

Decisions about the execution of a behavior are directly related to how information about that behavior is stored and accessed in memory. This is as true for drinking behavior as any other behavior. Memory processes are one possible means by which

both psychosocial and biological/genetic variables carry forward to influence future drinking decisions. Therefore, it would be useful to study differences between groups of drinkers' cognitive structures for the effects of alcohol. Furthermore, given the fact that problem drinking is heavily influenced by the environmental context, differences in cognitive structures for the effects of alcohol across situations would be of both theoretical and clinical interest. Over the last 10 to 15 years, specific cognitive methodologies have been developed that could be applied to study the cognitive structure of expectancies. These include multidimensional scaling and scaling with network structures (Pathfinder) (Cooke, Durso, & Schvaneveldt, 1986).

For the purpose of extending alcohol expectancy research it will be useful to draw upon spreading-activation theory (Collins & Loftus, 1975) which assumes that the meanings of words or concepts are represented by nodes and links of various strengths connecting the nodes. Upon processing or stimulation of a concept, activation spreads out along the paths of the network. The semantic network is organized by semantic similarity (e.g. closely associated concepts are closely linked and/or have many links to properties they share in common). Spreading-activation theory can best be seen as a general theory of representation, providing a common descriptive framework from which to propose more specific statements or models (Chang, 1986). For this reason, spreading-activation theory should be useful as framework to begin the investigation of the cognitive structure or

organization of the concept "effects of alcohol" in semantic memory. Upon clarification of global structures of alcohol knowledge, more specific hypotheses and models could be proposed which take into account the drinking context and the way the organization of alcohol expectancy knowledge influences decisions about drinking.

This research represents the first application of these procedures to help understand the structure of alcohol expectancies. Two specific applications are highlighted: 1) Individual differences between groups of drinkers' cognitive structures are examined via multidimensional scaling (Classical euclidian MDS) with PREFMAP (preference mapping: Carroll, 1972: Chang & Carroll, 1972) analyses, and 2) situational differences in subjects' cognitive structures are examined for a variety of different situations which were presented via audiotape.

STUDY 1

Content Analysis

The domain of possible items was identified by obtaining category norms for the concept "effects of alcohol". A sample of 587 undergraduate students was used. Sixty-four percent of the population was female and subjects ranged in age from 17 to 58 years old ($\underline{M}$ = 19.9). The subjects ranged from nondrinkers (4.5%) to moderate to heavy drinkers (e.g., 27.4% reported usually drinking 4 to 8 drinks in a sitting and 4.0% reported usually drinking more than 9 drinks per sitting).

The students were asked to generate, within 30 seconds, as

many adjectives as possible that would complete the phrase "alcohol makes one ____." The response frequencies for all words and phrases were tabulated and rank ordered. This process yielded 784 items consisting mostly of adjectives.

The same procedures where used to obtain word norms from a sample of male alcoholic subjects (N = 48) in inpatient alcoholism treatment. The vast majority of words given by the alcoholic subjects were also given by the students. This suggests that differences in drinking patterns should simply be reflected in differential availability of these words, not in the variety of words in the alcohol expectancy lexicon itself.

This initial item pool was given to three judges who eliminated items according to agreed upon criteria and grouped the words according to synonymous meaning (e.g. happy, joyous, cheerful). Then the judges eliminated low frequency words until five items were retained in each group. This was intended to assure that the final item pool would encompass every meaning category in the original item pool. This process resulted in 38 five item groups judged to have similar meaning.

Subjects

A separate subject sample consisting of 256 undergraduate students at the University of South Florida participated in the next phase of this study. Twenty-four subjects were eliminated because they were either individuals who have never had a drink, virtual abstainers, or recovering alcoholics. The remaining subjects (N =232) were males (37.1%) and females (62.9%) ranging

in age from 17 to 62 years old (M = 20.9). The majority of subjects were single (87.5%) and Caucasian (93.8%). The subjects ranged from light drinkers (9.5%) to heavy drinkers (e.g., 8.2% reported usually drinking more than 9 drinks in a sitting and 11.7% reported drinking 3 to 4 times per week or more).

Procedure

The initial expectancy item pool consisted of 190 words (mostly adjectives) related to the effects of alcohol. For each word, subjects responded to the statement "drinking alcohol makes me _____." Subjects were instructed to "indicate how often you think that this effect happens or could happen to you after drinking several drinks of alcohol" and told to "answer each item quickly according to your first impression." A seven point rating scale measuring frequency was employed for subjects to respond to each word with "never" and "always" as end points.

RESULTS

Item Analysis and Reliability

The reliabilities of the 38 five item scales ("iso-meaning" scales) ranged from .64 to .92 with a mean reliability of .85. Further inspection of the items by two judges resulted in the elimination of 4 groups of items with low reliability and heterogeneous meaning. In addition, the alpha and synonymous meaning of many of the scales increased or remained nearly unchanged when an item was eliminated. Thus, we eliminated one item from each scale. The reliabilities of the 34 remaining scales ranged from .70 to .91 with a mean of .83. The 34 four

item groups were then presented to 27 students (15 undergraduate and 13 graduate) to be rated on a 6 point scale according to the extent to which the words mean nearly the same thing in relation to each person's experience with alcohol use. Thirty-two of the four item groups had mean ratings in the agreement range. Of the two with mean ratings in the disagreement range, one was eliminated because it was judged to be a less important alcohol expectancy concept (e.g. vulnerable, helpless, immature, dependent) and one was retained because it was judged to be a critical expectancy concept (e.g. escape, cope, content, carefree) which warranted its inclusion despite the low agreement rating.

The final measurement device consists of 33 iso-meaning scales for a total of 132 items. Each of the scales was named by using the word with the highest item-total correlation in the iso-meaning group (see Table 1).

Validity

Evidence of concurrent (predictive) validity was established by the correlation of the scales with the quantity/frequency of alcohol consumption (see Table 1). Twenty-seven of the iso-meaning groups were significantly and positively correlated with drinking quantity frequency. These correlations ranged from .13 to .52 (M = .34). One scale was significantly negatively correlated with drinking quantity/frequency (r = -.12, p < .05). Five scales were not significantly correlated with drinking quantity/frequency. These correlations ranged from -.02 to .10.

Multidimensional Scaling

A 33x33 proximity matrix was constructed from the subjects data by calculating the Euclidian distance between all possible pairs of iso-meaning expectancy scales. This one-mode two-way data array was submitted to the ALSCAL collection of algorithms and analyzed by classical nonmetric multidimensional scaling procedures. The choice optimal dimensionality of the data was influenced by stress values, r^2, and interpretability. The r2 for one, two, and three dimensional solutions was .86, .95, and .98 respectively. The stress values for the one, two, and three dimensional solutions were .22, .11, and .06 respectively. Although, the three dimensional solution resulted in some improvement in stress and r2, the two dimensional solution was retained for it's simplicity, ease of interpretation, and because r2 and stress tended to "elbow" at two dimensions.

For the purpose of investigating differences between groups of drinkers, a smaller sample of 144 subjects were used. This group consisted of a random selection of females (N = 72) that could be matched on drinking/quantity frequency with an equal number of males (N = 72). Four levels of drinkers were defined by splitting the sample into quartiles of N = 36 with equal numbers of males and females. Each quartile represents 25% of the drinking frequency distribution from light drinkers to heavy drinkers. For each quartile, the mean ratings of the iso-meaning scales by each group of subjects were analyzed by PREFMAP (Carroll, 1972; Chang & Carroll, 1972), a computer program

designed to relate preference data to a multidimensional solution. In this case, input into the PREFMAP vector model was the two dimensional stimulus coordinates of the multidimensional solution and the mean ratings of the expected frequency of the iso-meaning alcohol effects for each group of subjects. PREFMAP found, for each group of drinkers, an ideal vector in the given stimulus space such that the linear correlation between the expected effects of alcohol (i.e. the "preference" data) and the projections of the stimulus points on the fitted vectors was maximized. The resultant multiple R's ranged from .96 to .99 indicating that the expected effects of alcohol can be fitted to the coordinates of the configuration.

Figure 1 presents the multidimensional scaling stimulus space for the 33 iso-meaning expectancy scales. Dimension 1 appears to reflect a social/positive vs. antisocial/negative continuum of expectancy iso-meaning groups, Dimension 2 appears to represent a arousing vs. sedating effects contimuum.

PREFMAP provides direction cosines of the fitted subject vectors the preference vectors for each group can be placed on the stimulus configuration. Figure 1 shows the PREFMAP vectors for light and heavy drinkers. Iso-meaning groups that are further out the regression line, in the direction of the arrow, are endorsed more frequently by the subjects and indicate the emphasis that group places on the dimensions. Thus, the PREFMAP vectors indicate that light drinkers expect effects such as sleepy, mellow. verbal, woozy, and sociable the most frequently

and heavy drinkers expect the effects sociable, jolly, fun, verbal, and energetic most frequently. In other words, heavy drinkers appeared to expect more social/positive and arousing effects than light drinkers.

STUDY 2

Nine prototypical situations representing a wide range of drinking contexts (e.g. meeting friend's in a bar, celebrating with family) were presented to subjects (N=271) via audiotape. The situations were derived through interviews with randomly selected subjects. The information obtained from these subjects was supplemented by previous research on drinking situations. The situations were rich in sensory information and read in a dramatic fashion by a female with acting experience.

After imagining themselves in each of the situations, subjects completed a brief alcohol expectancy instrument designed to be sensitive to situational variation in expectancies (Levine, 1989) (see Table 2). Proximities (i.e., euclidian distances) between the items were computed separately for each situation and submitted to the ALSCAL collection of algorithms to compute a classical MDS solution. The procedures and MDS analyses used were similar to those of Study 1. Two of these plots are presented in Figures 2 and 3. Several situational differences emerged when the stimulus configurations were examined. Both configurations appear to have dimensions of 1) power-control vs. ineptitude and 2) relaxation vs. sexual arousal. Expectancies

involving affect and behavior appear to be separate from other expectancies in the "dinner" situation whereas they appear to be integrated with other expectancies in the "sexual" situation.

CONCLUSION

These preliminary investigations represent the first attempt at clarifying the cognitive structure of alcohol expectancies via methodology designed for the study of concept formation. Preliminary validation for these approaches is provided by the observed differences in these structures across type of drinker as well as across situations. Determination of these cognitive structures will be useful in understanding the process by which individuals make decisions to drink and in designing interventions to prevent problem drinking.

The results of Study 1 suggest that positive and arousing effects of alcohol are strong associates for heavy drinkers, suggesting that this information may be rapidly retrieved (perhaps largely beneath conscious awareness) and disproportionately influence decision-making about drinking in heavy drinkers (i.e. an availability bias).

The results of Study 2 suggest that situational differences in drinkers cognitive structures can be studied via multidimensional scaling techniques using measures that are sensitive to contextual differences.

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Table 1: Iso-meaning Alcohol Expectancy Scales: Reliability and Correlation with Drinking Q/F

Scale	Alpha	r
Courageous	.88	.43**
Cope	.74	.42**
Sociable	.65	.41**
Noisy	.83	.40**
Horny	.89	.40**
Jolly	.88	.39**
Funny	.91	.39**
Energetic	.83	.35**
Smart	.79	.36**
Verbal	.82	.32**
Attractive	.82	.30**
Unpredictable	.81	.40**
Forceful	.80	.38**
Passout	.79	.38**
Mean	.81	.34**
Egotistical	.84	.34**
Dangerous	.87	.33**
Unbearable	.84	.33**
Mad	.87	.32**
Vulgar	.87	.32**
Undependable	.88	.27**
Emotional	.80	.27**
Incoherent	.78	.26**
Unhappy	.82	.09
Nervous	.76	.07
Intoxicated	.87	.52**
Wobbly	.89	.33**
Foolish	.79	.20**
Woozy	.77	.13*
Sick	.89	.07
Sleepy	.84	-.12*
Mellow	.70	.10
Slow	.85	-.02

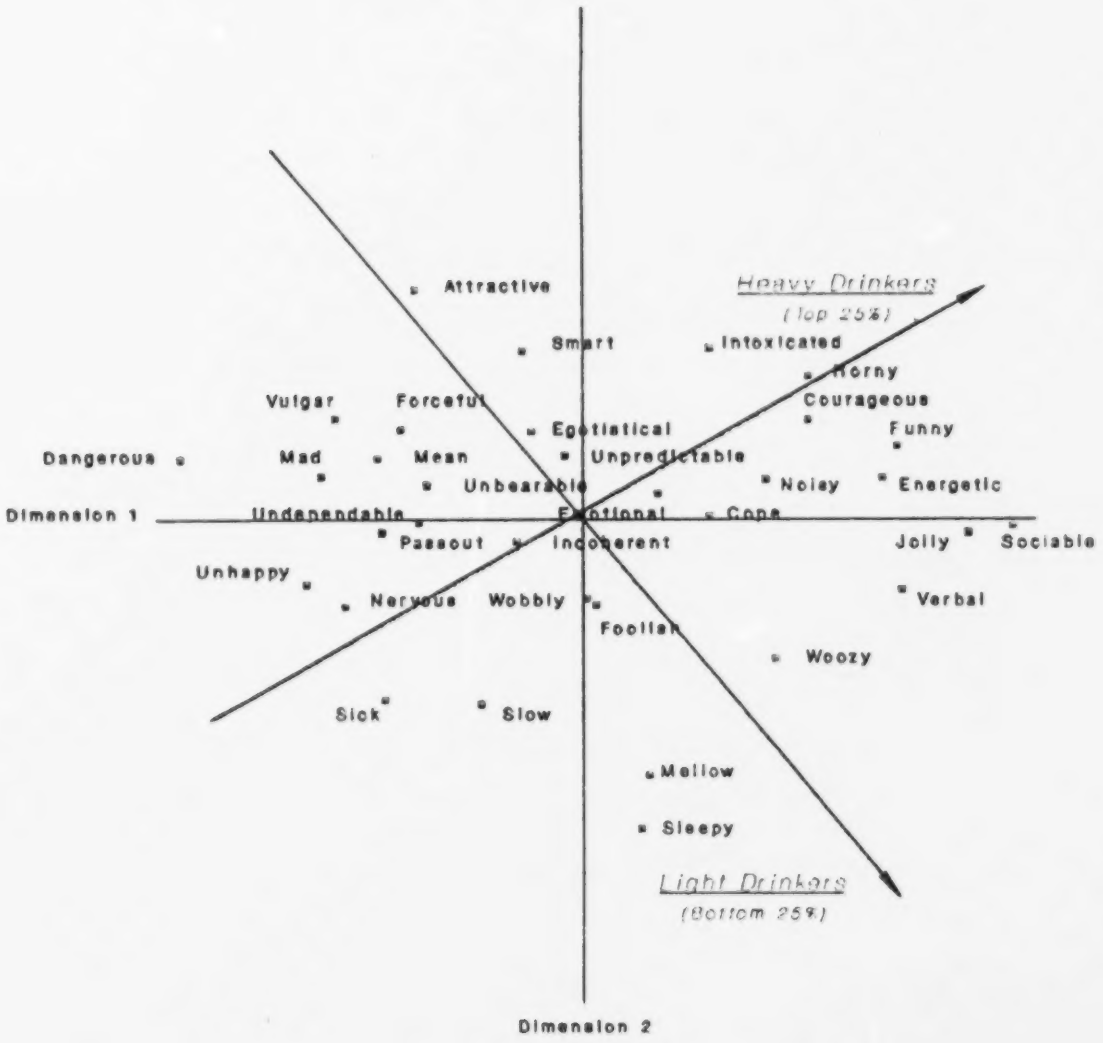
Note. Iso-meaning scales consist of 4 synonymous words. The scale is named by the word with the highest item-total correlation. (N = 232). * $p < .05$. ** $p < .001$.

TABLE 2
ECQ Factors and Representative Items

Factor Name	Representative Items*
Personality Transformation (4 items)	"...make a fool out of myself." "...feel like a different person."
Aggression (3 items)	"...more aggressive." "...get my way."
Relaxation (4 items)	"...calm my nerves." "...unwind."
Social/Sexual (4 items)	"...loosen up my sexual inhibitions." "...more outgoing."
Global Positive Affect (6 items)	"...happier." "...energetic."

*All items begin with the phrase "Alcohol will make me..."

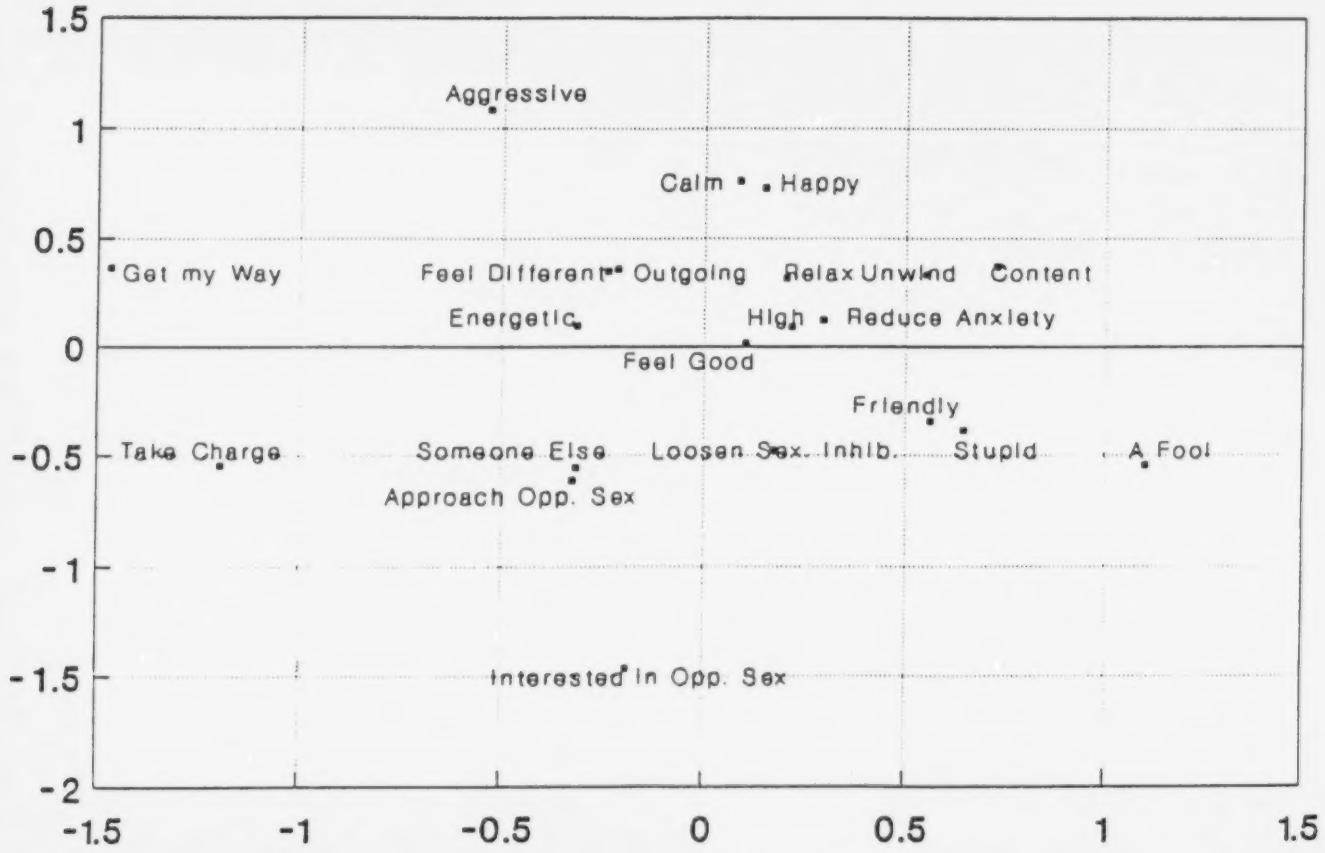
Figure 1: MDS of Iso-meaning Alcohol Expectancy Scales with PREFMAP Expected Effects Vectors of Two Drinking Groups



Note. Dimension 1 = Positive/social vs. Negative/antisocial effects. Dimension 2 = Arousing vs. Sedating Effects.

Figure 2

MDS of alcohol expectancy items in an explicit sexual situation. *

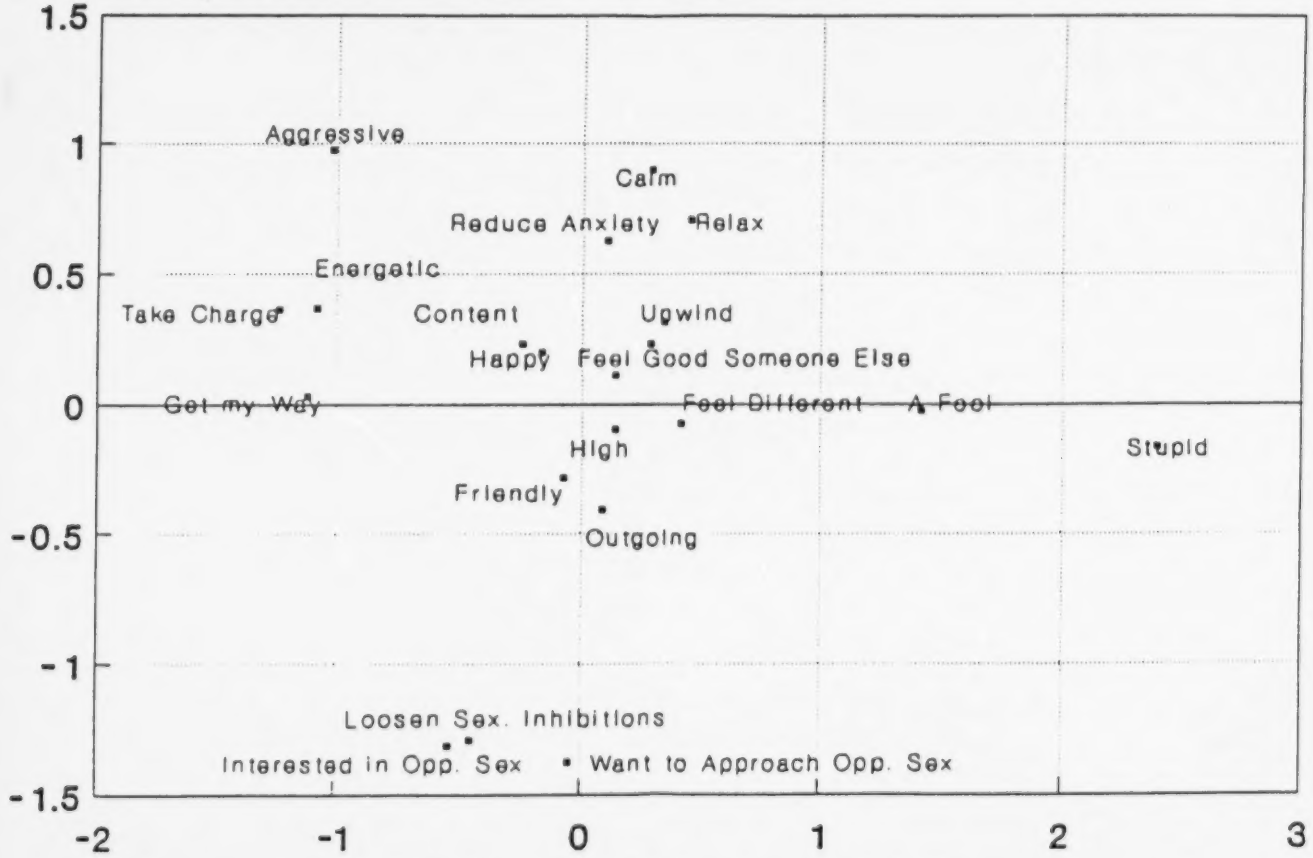


*All items begin with "In this situation, alcohol will make me..."

Note: Stress=.068, R-square=.988

Figure 3

MDS of alcohol expectancy items in a "dinner with platonic friend" situation. *



*All items begin with "In this situation, alcohol will make me..."

Note: Stress=.105, R-square=.962